

DIDACTIC DESIGN FOR IMPROVEMENT PHASE THINKING ABILITY AND DISPOSITION REFLECTIVE THINKING IN MATHEMATICS

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Abstract

This study is back grounded by the importance of Mathematical Reflective Thinking Ability (MRTA) to support mathematical critical thinking ability. That ability support the success in another ability in mathematic such as solving the problem in mathematic. Mathematical Reflective Thinking Ability also indicate mathematical reflective thinking disposition (MRTD). Mathematical reflective thinking ability and disposition which had been examined in earlier study only determine its indicator and has not determined its stage. This stage is important in order to find out which level someone had achieved it. Didactical design also support the enhancement of MRTA and MRTD, therefore in this study didactical design will also developed to enhance the stage of mathematical reflective thinking ability and disposition. Thus, the special target of this study is to obtain the stage or level of MRTA and MRTD along with didactical design which support its enhancement. The method which is done to obtain stage and didactical design of MRTA and MRTD is by development research method. The activity of MRTA and MRTD stage development and also didactical design is planned in 2 years. The development activity comprise theoretical study, draft arrangement of MRTA and MRTD and didactical design which support its enhancement, expert test, revision, pilot test with limited and wide scale. The subjects of study are Senior High School students. The result obtain 7 stages of MRTA and 3 stages of MRTD. The initial draft of didactical design for this MRTA and MRTD enhancement comprise those stages.

Keywords: *Didactical Design, Stage, Reflective Thinking, Disposition*

INTRODUCTION

Mathematical reflective thinking ability which has been developed by Nindiasari (2013) is ability to interpret a case based on mathematic concept involved, ability to evaluate the truth of an argument, ability to draw the analogy from two similar cases, ability to analyze and clarify question and answer, ability to generalize, ability to distinguish between relevant and not relevant data. Mathematical reflective thinking ability which has been developed is intended to Senior High School students but it is possible beyond senior high school level.

Mathematical reflective thinking ability possessed by someone is related with his/her disposition. According to Nindiasari (2013), reflective thinking disposition is a tendency to think and act positively from certain thinking ability he/she possessed. Someone who posses reflective thinking disposition who has a tendency to think, act and has a certain attitude reflect someone who has possessed that ability.

As for indicator of mathematical reflective thinking disposition which has been developed by Nindiasari (2013) is a tendency to act which comprise: asking about mathematic clearly and reasonably; using reliable mathematic source; viewing that a mathematic topic is part of whole mathematic which is broader; back to main problems; trying out various mathematic strategies; open-minded, flexible in mathematic; act quickly in solving mathematic

problem; sensitive toward the others feeling related with mathematic; utilizing the way of other people think critically in mathematic; comparing mathematic knowledge which is just obtained with the knowledge which had been possessed; giving feedback toward mathematic activity; giving the reason which is related with mathematic activity; discourse with him/herself; doing assessment toward mathematic learning process.

Mathematical reflective thinking ability (MRTA) and mathematical reflective disposition ability (MRDA) need to be supported by didactical design by teacher in class. The effective teacher is teacher who always provide opportunity to students and make them aware to develop MRTA and MRDA. Teacher who has knew his students stage in MRTA and MRDA should immediately design the supporting didactical design to enhance MRTA and MRDA. Didactical design is how teacher give lesson material in order to be mastered and possessed by students. Didactical design which will be designed is teacher's didactical design in enhancing MRTA and MRDA stages.

Therefore, based on the explanation above, then **Formulation of Problem** in this study are:

1. How do the stage and arrangement of level of MRTA and MRDA toward Senior High School students?
2. How does the didactical design which support the stage of MRTA and MRDA enhancement?

METHOD OF STUDY

This study use development research method. This method is applied because the aim of this study generate the stage of thinking and disposition ability in mathematical reflective thinking and didactical design to enhance its stages. The procedures of study consist of 3 stages, namely: 1. Introduction study (theoretical study), 2. The stage of mathematical reflective thinking disposition and ability and didactical design, 3. Test the stage of mathematical reflective thinking ability and disposition and also didactical design.

In introduction study as first stage, activities which are done in the form of: bibliography study; arrangement of mathematical reflective thinking ability and disposition stages of didactical design learning for its enhancement, and field survey. The activity of MRTA and MRDA stages development is doing expert test and the final activity is limited and wide pilot test. The subjects of pilot test to see the stages of MRTA and MRDA and the enhancement of didactical design are Senior High School students in Serang City.

RESULT AND DISCUSSION

The Examination of Theoretical Study and Stages of MRTA

Certainly, to determine the stages of MRTA the theory which support it and indicators which were developed before need to be reexamined. As for results of theoretical study which is related with this are as follow:

This notion of reflective thinking belongs to theory which is suggested by John Dewey in 1933 (Phan, 2006). John Dewey define it as one mode of thinking: active, persevering, and careful consideration toward some beliefs or form of knowledge based on foundations which support it and the future conclusions on teaching and learning process, reflective thinking develop meaningful learning and help students and educators to develop certain abilities which help them to become more vocal and critical and develop expertise in professionalism areas.

Eby & Kujawa (Lee, 2005) explain about reflective thinking model which comprise: Observing, Reflecting, Gathering data, Considering moral principles, Making a judgment, Considering strategies, action. Mizirow (Phan, 2006) suggest four stages of reflective thinking activity namely habitual action, understanding, reflection, and critical thinking. Habitual action is a mechanic and automatic activity which is done by a little conscious thinking. Understanding is learning and reading without connecting with another situations. Reflection concerned with active, persevering, careful consideration toward assumption or believe based on our consciousness. Finally, critical thinking is considered as highest level of reflective

thinking which involve us to more realize why we perceive things, the way we feel, act and doing something, Mezirow (Phan, 2006). Mann (2006) categorize reflective thinking ability in analyzing problem solving in analytic geometry field consist of some stages namely: selecting technique, monitoring solution process, insight, and conceptualization (the relation of concept and meaning such as doing manipulation from existing concept then giving meaning and interpretation).

Therefore, from some expert opinions which have been explained above, the conclusions can be drawn that stages of mathematical reflective thinking ability (MRTA) comprise:

Stage 1 : Observing

Stage 2: Understanding the problem

Stage 3: Gathering data

Stage 4: Making judgment from data gathered

Stage 5: Selecting strategies in solving problem (selecting solution technique) and insight.

Stage 6: Conceptualization

Stage 7: Monitoring solution.

The Examination of Theoretical Study and Stages of MRDT

Thinking disposition itself is tendency to think and act positively as result of certain ability possessed. This thinking disposition need to be developed through thinking skill and ability development. Thinking disposition will shape student's intellectual character in order to face all challenges in the future and capable to solve the problem well. This is parallel with our curriculum which give priority to character education.

Based on MRDT indicator which had been developed by Nindiasari in 2013, then stages of mathematical reflective thinking disposition (MRTD) is developed. This stage is taken firstly based on theoretical study which then based on observation, this stage is seen in accord with displaying of student performance in action and attitude which posses mathematical reflective thinking ability. As for analysis result of MRDT stages are as follow:

Stage (1): Try to understand mathematic well (showed by asking about mathematic clearly and reasonable, using reliable mathematic source, viewing that a mathematic topic is part of broader mathematic, comparing mathematic knowledge which is just obtained with knowledge which has been possessed; Stage (2): Sensitive to others feeling concerned with mathematic; Stage (3): Try to solve mathematic problem well which is showed by: try to return to main problem; try various mathematic strategy; open-minded, flexible concerned with mathematic; act quickly in solving mathematic problem; doing feedback toward mathematic activity; giving the reason which is concerned with mathematic activity based on personal judgment; doing discourse with his/herself; utilizing the way of other people think critically in mathematic.

Initial Draft of Didactical Design of MRTA and MRDA Stages Enhancement

Didactical design is designed by teacher in order that learning process in class is more effective. Didactical design comprise teacher activity interacting with student in understanding well material or teaching material. Didactical design can be planned through learning scenario making and teaching material.

Teacher can design didactical situation which is hoped to appear in class and students can adapt with teaching material which is given. For example, didactical situation which can be risen such as in the beginning of learning, teacher start the activity by doing an action for example in the form of explaining a concept, present contextual problem, or present mathematic game. Based on that situation, student will interact so new information source is created which then will become new information for teacher. Therefore, new didactical situation is formed based on teacher follow up action as response to student action toward didactical situation before. According to Suryadi (2005), didactical design can be described through:

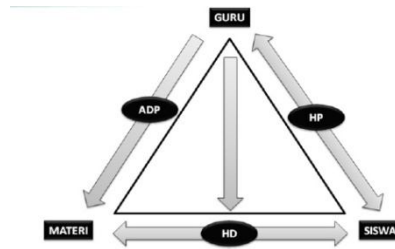


Figure 1. Didactical design

Didactical design in figure above show pedagogical relation between teacher and student (HP), didactical relation between material and student and also teacher (HD); teacher and material as anticipation of pedagogy design (ADP).

Therefore, what is means by didactical design arrangement in this study is teaching material arrangement which based on Learning Obstacle of mathematical reflective thinking ability. This design also hope to be able to enhance MRTA and MRDA stages which have been possessed by students.

Steps in making didactical design to enhance MRTA and MRDA stages are as follow:

1. Arranging initial MRTA and MRDA stages based on indicator which has been developed before.
2. Determining material (the material selected is statistic and change). This material still considered difficult and its advantage is very meaningful in daily life application.
3. Examining MRTA and MRDA instrument which is suited with material discussed.
4. Making observation and interview guidance which is related with MRTA and MRDA stages.
5. Arranging initial didactical design to enhance MRTA and MRDA stages.
6. Doing expert test related with initial didactical design.

Result of Initial Didactical Design Draft

Didactical design which is made is teaching material in statistic and change materials. This didactical design aim to enhance Mathematical Reflective Thinking Ability (MRTA) and Mathematical Reflective Thinking Disposition (MRDA). The reason to select change and statistic material because many students still have difficulty to learn those materials. Teaching material which is developed are Student Worksheet which is systematically comprise:

1. Title of material
2. Material which support the solution of problem
3. Problem which demand Mathematical Reflective Thinking Ability (MRTA)
4. Question guidance to enhance MRTA and MRDA

In this student worksheet, brief material which support its solution is posed. To enhance MRTA stages, questions are guided to enhance MRTA and MRDA stages.

For example, to enhance stage 2 of understanding problem, the question is posed on this student worksheet as follow:

Read carefully the problem above. Then write what can you understand about the problem above and things which support it? What prerequisite material which have you been learn before to solve that problem?

To enhance stage of gathering data, the question is posed:

How about the data which can be gathered from problem above?

To enhance stage of judgment of data gathered, the question is posed:

Is those data is enough to solve the problem in item above? Why? If is not enough, what data which is needed?

To enhance stage 5, the question is posed:

Based on steps of solution strategy which has been arranged, do the solution! Write formulation and concept which support that solution!

From the work outcome in part above, is there anything which has not been appropriate? If there is one, correct that steps!

As for MRDA on student worksheet, question and activity are posed which support the enhancement of MRDA stages.

For example, for enhancement of stage 1 and 2, question, command and activity situation are posed:

Command:

To solve the stage of next question, discuss with your friend in your group!

This command will encourage student activity to interact mutually, smart students help their friend who is weak, and this can develop sensitive attitude toward other person feeling concern with mathematic.

To enhance stage 1, the command is:

Based on understanding of problem, data, data with its judgment, how the strategy or your way to solve the problem in item above? (note: to determine the solution of this problem, you can search another book sources which are relevant).

Students are commanded to understand the problem above and in searching the solution of problem, they are commanded to search another book sources which are relevant.

To enhance stage 3, question and command are developed:

Based on steps of solution strategy which has been arranged, do the solution! Write the formulation or concept which support that solution!

.....

From the work outcome in part above, is there anything which has not been appropriate? If there is one, correct those steps!

.....

Is there another way to solve the problem above? Explain it!

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Check your answer result to all of your friends! (Your friend in your group or one whom you consider smart!)

The result of your friend correction:

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Pay attention to this!

Ask the question to yourself, for example: Have I understood about the solution of this problem? Is there another way which can be used to solve this problem? What material which support the solution of the problem above? How the way I learn in order can solve this problem or understand mathematic material?

Design which had been developed then tested for validation by mathematic education expert and 3 mathematic teachers. The result of didactical design pilot test is seen from content validity and face validity which show that it is valid almost average both from content and face, only in some item, there are sentences which needed to be corrected. After being corrected, then field survey to school is conducted to see readability and understanding of teaching material draft in Senior High School students. This survey is conducted in 3 schools in Serang City. The result is they have understood the content of reading and only some sentences which needed to be clarified. The conclusion is that teaching material draft to MRTA and MRDA enhancement can be continued in next stage, namely pilot test stage in limited scale.

The result of student worksheet draft for students in 3 schools, for students with high, medium and low category student in average have understood the problem intended by completing in each step or part of question for MRTA stage enhancement in each indicator.

CONCLUSION AND SUGGESTION

CONCLUSION

This study conclude that:

1. Mathematical Reflective Thinking Ability (MRTA) Stage comprise: Stage 1: observing; Stage 2: understanding the problem; Stage 3: gathering the data; Stage 4: making judgment of data gathered; Stage 5: selecting strategies in solving the problem and insight; Stage 6: conceptualization; Stage 7: monitoring solution.
2. MRDA consist of 3 stages, namely: Stage 1: Try to understand mathematic well; Stage 2: Sensitive to other person feeling concerning with mathematic; Stage 3: Try to solve the mathematic problem well which is showed by: trying to return/relevant to main problem; trying various mathematic strategy; open-minded, flexible concerning with mathematic, act quickly in solving mathematic problem; doing feedback toward mathematic activity; giving the reason concerning with activity.
3. Initial draft of didactical design in the form of teaching material which emphasize pupil worksheet which contain: material, MRTA item, question guidance toward MRTA and MRDA enhancement.

SUGGESTION

1. The enhancement of MRTA stage need to be done by developing teaching material, for example in the form of pupil worksheet in which student is guided to be able to enhance that MRTA stage.
2. This stage only can be seen in Senior High School students without seeing learning style. It is suggested that MRTA and MRDA stages to be examined based on student's learning style.
3. Didactical design which is developed here need to be supported by learning model which can enhance MRTA and MRDA stages.

BIBLIOGRAPHY

- Lee, H.J. (2005). Understanding and assessing preservice teachers reflective thinking. *Teaching and Teacher Education Journal*, 21 (2005) 699-715. USA: Elsevier. Tersedia pada: <http://gsueds2007.pbworks.com/f/preservice%20reflection.pdf>. Diakses tanggal: 4 November 2010.
- Nindiasari, H. (2013). *Meningkatkan Kemampuan dan Disposisi Berpikir Reflektif Matematis serta Kemandirian Belajar Siswa SMA melalui Pembelajaran dengan Pendekatan Metakognitif*. Disertasi Doktor pada Sekolah Pasca Sarjana UPI. Bandung: Tidak diterbitkan.
- Noer, S.H. (2010). *Peningkatan Kemampuan Berpikir Kritis, Kreatif dan Reflektif (K2R) Matematis Siswa SMP melalui Pembelajaran Berbasis Masalah*. Disertasi Doktor pada SPs UPI. Bandung: Tidak diterbitkan
- Phan, H.P. (2006). Examination of student learning approaches, reflective thinking, and epistemological beliefs: A latent variables approach. *Electronic Journal of Research in Educational Psychology*, No. 10 Vol4(3),2006,pp:557-610. Tersedia pada: http://www.investigacion-psicopedagogica.org/revista/articulos/10/english/Art_10_141.pdf. Diakses Tanggal: 4 November 2010.
- Ratnaningsih,N.(2007).*Pengaruh Pembelajaran Kontekstual terhadap Kemampuan Berpikir Kritis dan Kreatif Matematis Serta Kemandirian Belajar Siswa SMA*. Disertasi pada SPs UPI. Bandung: Tidak diterbitkan
- Sumarmo, U. (2011). *Berpikir dan Disposisi Matematik: Apa, Mengapa, dan Bagaimana Dikembangkan pada Peserta Didik*. Bandung: FPMIPA UPI.
- Zehavi & Mann. (2006). *Instrumented Techniques and Reflective Thinking in Analytic Geometry*. (Online). (Tersedia Pada: www.math.umd.edu/tmme/vol2no2/TMMEv2n2a1.pdf . Diakses tanggal 6 Februari 2011
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